



FCC Ex Parte Presentation: Implementation of ATSC Standards

July 25, 2011

Always Innovating. Always There.

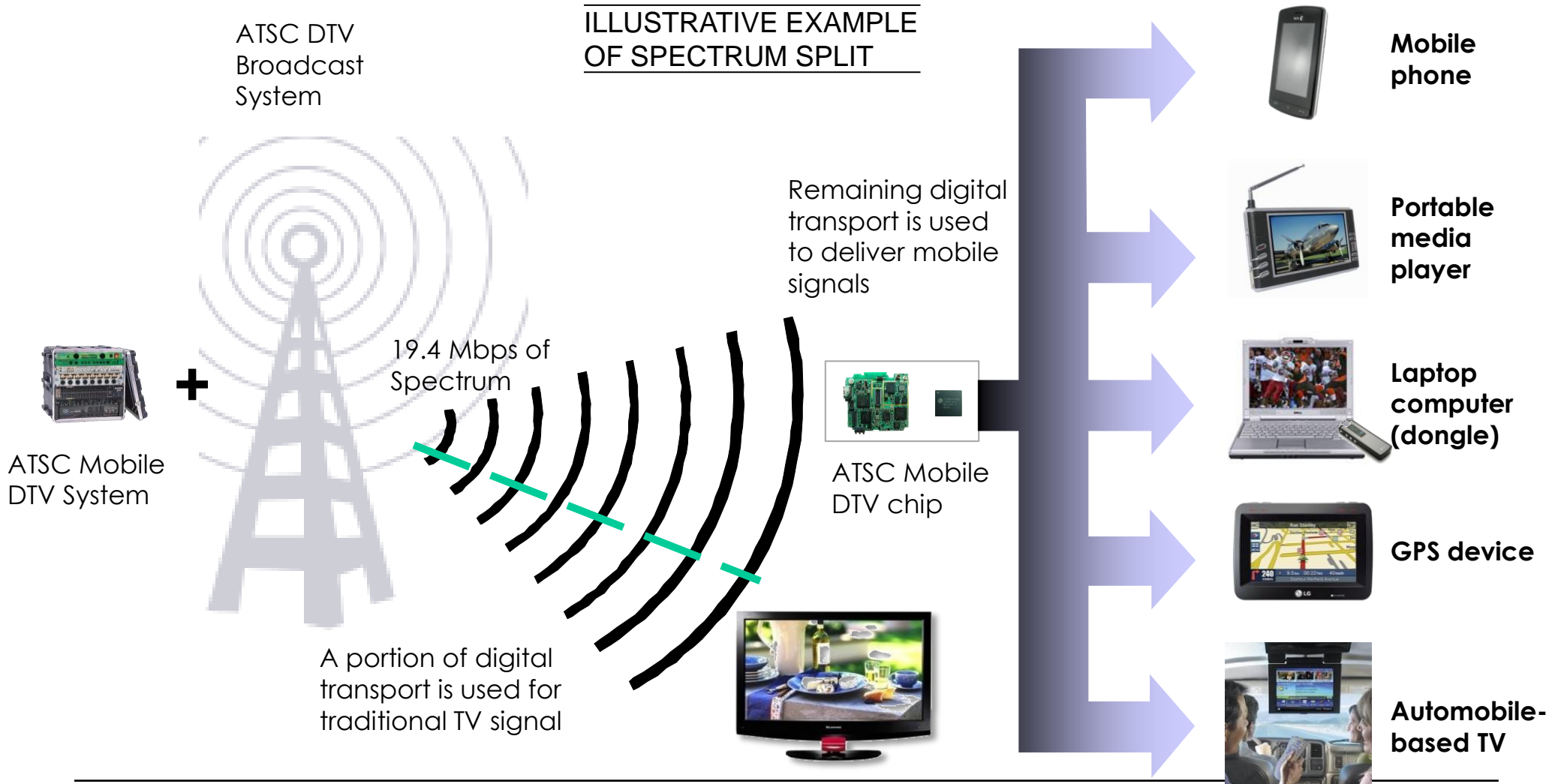
ATSC Mobile DTV Overview



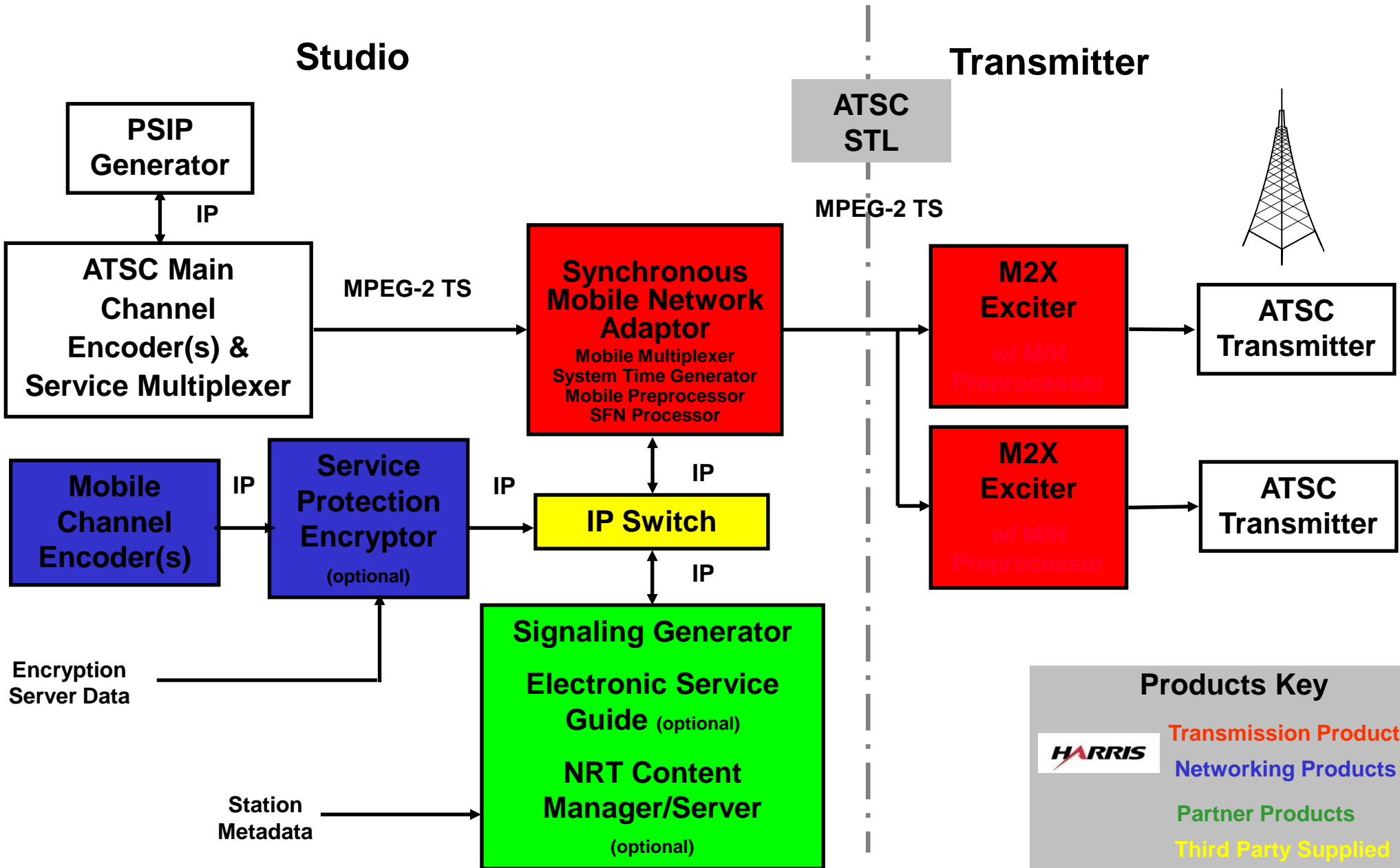
DTV stations transmit mobile TV signal with addition of ATSC Mobile DTV system

Consumers receive mobile TV signal on many different devices via ATSC Mobile DTV chip and module

ILLUSTRATIVE EXAMPLE OF SPECTRUM SPLIT



System Architecture with Full ATSC M/H & SFN



- **Robust physical layer**
 - High immunity to drop-outs and burst noise
 - No need for receiver antenna diversity
 - Up to 12.5 db system gain over regular ATSC channel
 - High-Speed reception – up to 300 km/h
- **Data efficient and completely scalable**
 - 3.667 Mbps of ATSC TS could provide up to 980 Kbps mobile/handheld service
 - Scalable coding for selectable robustness of signal
 - Efficiency ranges from 37% to 17% depending on the level of coding
- **Power savings for handheld devices due to burst transmission**
 - Allows receiver RF circuitry to be ON part-time to save battery life

- IP based mobile payload
 - Supports stream and non real time file delivery
 - Enables cross media compatibility
 - Utilizes efficient AVC h.264 video coding and AAC-HE audio coding
- Each RF channel is capable of delivering up to 8 individually coded mobile IP data streams (Ensemble)
 - Each IP data stream can support multiple services...Video+Audio, Audio only, Service Guide, NRT services, etc.
 - System maintains at least 4.7 Mbps legacy ATSC in TS
- System supports service protection which enables
 - Viewer identification
 - Access control
 - Paid service offerings

-
- LG
 - Samsung
 - Dell
 - Hauppauge
 - Vizio
 - Wiengard
 - Valups
 - Pixtree
 - Crestech
 - Dotel
 - Enspert
 - iMovee
 - DTV Interactive
 - Emperor Corp.
 - Michley Tivax

Eighteen receiver manufacturers showed ATSC Mobile DTV receiving devices at CES 2011

- 100K sold in Japan for iPhone & iPod Touch within the first year.
- 1st ATSC host device – iPhone, iPad & iPod Touch
- Clients being developed in other markets for RIM, Nokia, Samsung Jet (CDMA), LG Arena (CDMA)
- Other types of devices
 - PC
 - Portable TV
 - Digital Photo Frame
 - In-vehicle – backseat & navigator

SoftBank

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HOME iPhone

HOME > iPhone > One Seg Digital TV on iPhone. It's Finally Here.

One Seg Digital TV on iPhone. It's Finally Here. TV & Battery

A Worldwide First, Digital TV on iPhone

Enjoy Brilliant Visuals in the Palm of Your Hand

No cables or bothersome settings. Now, for the first time ever¹, watch Digital TV on iPhone's large display. One Seg tuner, TV & Battery, receives and transmits signals to iPhone, which adjusts settings automatically using free² One Seg Digital TV app.

¹ According to December 1, 2008 RCA Survey.
² Downloading free Digital TV app may incur packet communications fees depending on download method.

Getting Out and About in Style

TV & Battery is styled to complement iPhone. Small enough to fit comfortably in hand or pocket. Travel light and enjoy One Seg Digital TV broadcasts anywhere, anytime.

Making the Fun Last Longer

Use TV & Battery to charge iPhone battery. Connect with iPhone using bundled USB Cable to restore iPhone power in minutes.

One Seg Tuner for iPhone, TV & Battery
An integrated One Seg Digital TV tuner and iPhone battery charger

Available Now

Available throughout Japan at SoftBank Shops offering iPhone

Settings & Specifications

TV & Battery

- ▶ User Support Center (Japanese)
- ▶ Update Information (Japanese)

Provided by SOFTBANK BB

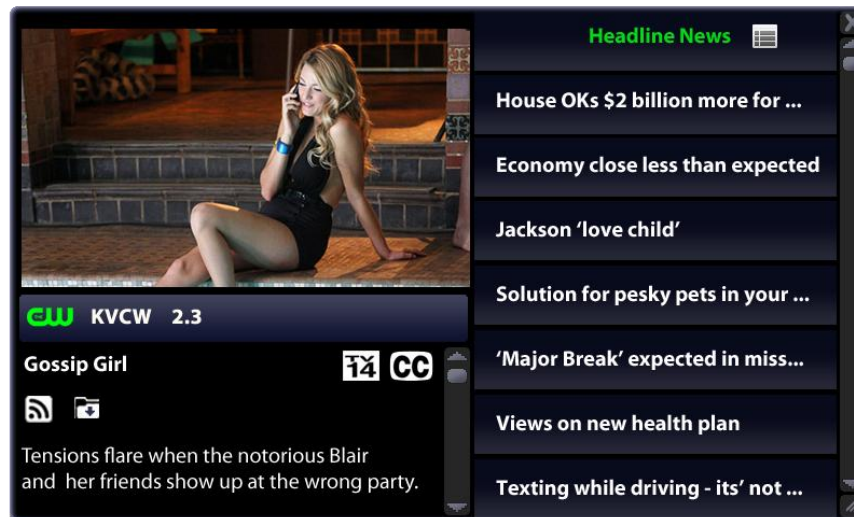
How Tivizen Works



- Pairs with host device over WiFi
- Can be located in area of strong signal strength
- Battery offers backup power to host device
- Also supports PVR function with “Sling box-like” feature



- Mobile DTV initial focus: Television services
- Widgets add broadcast data services to the mix
- Types: Global or Synchronized
 - Global: Not associated with a TV/radio service, e.g. news
 - Synchronized: Associated with and synchronized to TV channel/program, e.g. merchandising



- Traditional video and audio is just the start!
 - Electronic Coupon delivery
 - Auto Stereo 3D on a mobile device
 - Mobile Digital Signage
 - RSScaster and Clipcaster
 - Traffic and Travel Information
 - Emergency Alerting
 - Interactive “Tweeting” with program participants

Mobile DTV Applications Sample



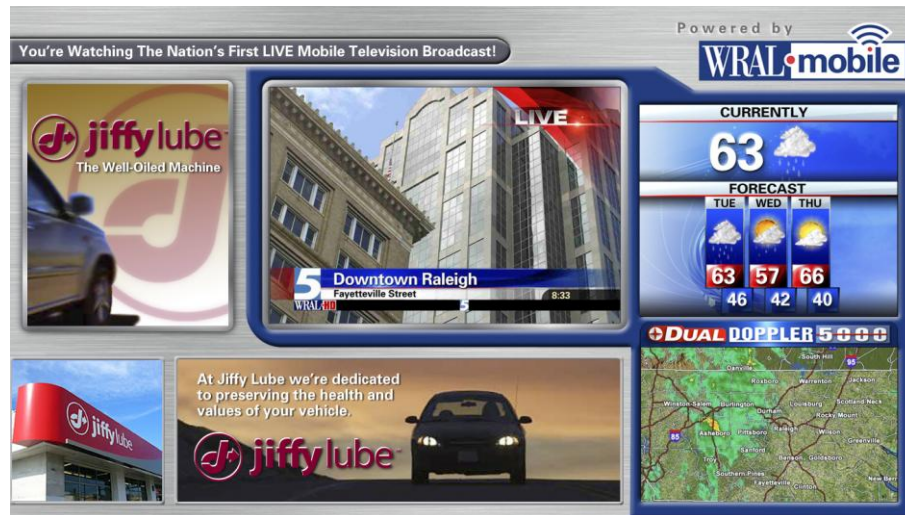
Electronic Couponing



Mobile 3DTV



Interactivity



Digital Signage

Bandwidth Requirements

Studio Facility Requirements

Transmitter Requirements

Optimizing Mobile Coverage

Main Channel Basics

- ATSC A/53 has 19.39 Mbps payload capability
- The FCC requires all digital broadcasters to provide at a minimum 1 SD *NTSC quality* free-to-air program service
- ATSC program guide (PSIP) requires about 0.5 Mbps
- Typical SD service in MPEG2 requires 2-4 Mbps
- Typical HD service in MPEG2 requires 10-14 Mbps

Mobile DTV Basics

- ATSC Mobile DTV channels are scaleable in number and level of robustness
- Robustness is a function of coding level and it also drives payload efficiency
 - Half rate = 37% , Mixed rate = 26% , Quarter rate=17%
- Streams with the same level of robustness (coding) can be assembled into an ensemble
- Main channel contribution is made in increments (Groups)
 - .917mbps, 1.83mbps, 2.750mbps, 3.667mbps, 4.584mbps
5.501mbps, 6.418mbps, 7.334mbps

SCCC Outer Code Rate (for each Group Region)									
A	B	C	D	P	NoG	NP	ET (=EP)	PDRP (Kbps)	MDRL (Mbps)
1/2	1/2	1/2	1/2	48	1	202	34.1	312.2	0.917
					2	407	34.3	629.1	1.834
					3	612	34.4	945.9	2.750
					4	817	34.4	1262.8	3.667
					5	1021	34.4	1578.1	4.584
					6	1226	34.4	1894.9	5.501
					7	1431	34.5	2211.8	6.418
					8	1636	34.5	2528.7	7.334

PDRP = Payload Data Rate for Ensemble

MDRL = Main Data Rate applied to MDTV

Mixed Rate Mode



SCCC Outer Code Rate (for each Group Region)									
A	B	C	D	P	NoG	NP	ET (=EP)	PDRP (Kbps)	MDRL (Mbps)
1/2	1/4	1/4	1/4	48	1	155	26.1	239.6	0.917
					2	313	26.4	483.8	1.834
					3	471	26.5	728.0	2.750
					4	628	26.5	970.7	3.667
					5	786	26.5	1214.9	4.584
					6	944	26.5	1459.1	5.501
					7	1102	26.5	1703.3	6.418
					8	1259	26.5	1946.0	7.334

PDRP = Payload Data Rate for Ensemble

MDRL = Main Data Rate applied to MDTV

Quarter Rate Mode



SCCC Outer Code Rate (for each Group Region)									
A	B	C	D	P	NoG	NP	ET (=EP)	PDRP (Kbps)	MDRL (Mbps)
1/4	1/4	1/4	1/4	48	1	202	16.9	154.6	0.917
					2	407	17.0	312.2	1.834
					3	612	17.1	471.4	2.750
					4	817	17.2	629.1	3.667
					5	1021	17.2	786.7	4.584
					6	1226	17.2	945.5	5.501
					7	1431	17.2	1103.6	6.418
					8	1636	17.2	1262.8	7.334

PDRP = Payload Data Rate for Ensemble

MDRL = Main Data Rate applied to MDTV

Example: Two high-quality programs



Two high-quality programs - 1/2, 1/4, 1/4, 1/4

Video bit rate	1100 kbps
Audio bitrate	48 kbps
Overhead	62 kbps
Total MH bandwidth	4.585 Mbps
Remaining Legacy DTV Bandwidth	14.805 Mbps

Two high-quality programs - 1/4, 1/4, 1/4, 1/4

Video bit rate	1100 kbps
Audio bitrate	48 kbps
Overhead	106 kbps
Total MH bandwidth	7.336 Mbps
Remaining Legacy DTV Bandwidth	12.054 Mbps

Example: Two mid-quality programs



Two mid-quality programs - 1/2, 1/4, 1/4, 1/4

Video bit rate	800 kbps
Audio bitrate	48 kbps
Overhead	120 kbps
Total MH bandwidth	3.668 Mbps
Remaining Legacy DTV Bandwidth	15.722 Mbps

Two mid-quality programs - 1/4, 1/4, 1/4, 1/4

Video bit rate	800 kbps
Audio bitrate	48 kbps
Overhead	92 kbps
Total MH bandwidth	5.502 Mbps
Remaining Legacy DTV Bandwidth	13.888 Mbps

- ATSC Mobile DTV reception is based on different planning factors than terrestrial DTV reception
 - Receive antenna height 45" vs. 30 ft.
 - Receive antenna gain -20db to -3db vs. 0db
 - System SNR 3.5 – 7.0db vs. 15db
- Field testing has shown that the “radio horizon” is the limit to reliable mobile/handheld coverage
 - Typically line of sight from TX antenna to receiver
 - Limitations typically are terrain and buildings
 - Flat terrain + tall towers + H&V pol + max power = 35-45 mile coverage

Average Received Signal Strength UHF vs. VHF

Link Budget Differences

	VHF	UHF
Antenna Gain	-3.1 dB	0.0 dB
Tx Power	-4.0 dB	0.0 dB
Tx Cable	3.6 dB	0.0 dB
Rx Cable	0.5 dB	0.0 dB
Rx Ant. VSWR	-9.5 dB	0.0 dB
Free space loss	9.8 dB	0.0 dB
Adjustment Factor	-2.7 dB	0.0 dB

Average Field Strength

	UHF	VHF	Adjusted VHF
Open	-31.8 dBm	-56.0 dBm	-53.3 dBm
Woods	-38.2 dBm	-55.7 dBm	-53.0 dBm
Office	-45.2 dBm	-72.0 dBm	-69.3 dBm
House	-57.9 dBm	-75.2 dBm	-72.5 dBm
Vehicle	-40.6 dBm	-64.9 dBm	-62.2 dBm
Avg	-42.7 dBm	-64.8 dBm	-62.1 dBm

VHF had 19.4 dB less average signal strength than UHF

Harold Wheeler defined the fundamental limitations of electrically small antennas based on their size

**Electrically small antenna – max dimension
 $\leq \lambda/2\pi$**

**~3" UHF
~8.5" VHF**

Max power factor: $P_{\max} = (ka)^3$

a = antenna volume radius

$k = 2\pi/\lambda$

Solve for the max power ratio difference between 210 MHz and 700 MHz

$$\frac{\rho_v}{\rho_u} = 10 \log \left[\frac{\left(\frac{2\pi}{\lambda_v} a \right)^3}{\left(\frac{2\pi}{\lambda_u} a \right)^3} \right] = 10 \log \left(\left(\frac{\lambda_u}{\lambda_v} \right)^3 \right) \approx -15 \text{ dB}$$

Wheeler Limit dictates the best VHF/UHF receive ratio of an electrically small antenna will be -15 dB

- Broadcast equipment manufacturers are continuously innovating and looking to implement greater efficiencies to maximize the power of the ATSC standard and broadcasters use of bandwidth to offer more innovative services.
- Decisions on the necessary bandwidth for broadcasters must be informed and based on the needs of future broadcast services/applications. Decisions should not be solely based on maintaining the status quo.
- There are constraints utilizing the VHF spectrum for Mobile DTV services that must be understood. Broadcasters should not be forced into the VHF spectrum
- Any channel sharing or auction paradigm must be implemented on a voluntary basis and provide broadcasters the ability maintain their current level of service and implement new service offerings (i.e., MDTV and NRT).

Thank You!

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